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SPECIFICATION FOR AUTOCOLLIMATOR

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MANAK BHAVAN, 9 BAHADUR SHAH ZAFAR MARG
NEW DELHI 110002

December 1979

AMENDMENT NO. 1 JANUARY 1982
TO
IS:9107-1979 SPECIFICATION FOR AUTOCOLLIMATOR

Corrigendum

(*Page 7, clause 2.1.6*) - Substitute the following for the existing clause:

'2.1.6 *Eyepiece* - A Ramsden/Kellner/orthoscopic type eyepiece for viewing the setting graticule located at its focal plane.'

(EDC 36)

Reprographic Unit, ISI, New Delhi, India.

AMENDMENT NO. 2 AUGUST 2000
TO
IS 9107 : 1979 SPECIFICATION FOR AUTOCOLLIMATOR

(*Page* 11, *clause* 5.2.2.2) — Substitute 'IS 10236 (Part 10) : 1985* and IS 10236 (Part 12) : 1985†' *for* 'IS 2352 : 1963*.'

(*Page* 11, *footnote with* '*' *mark*) — Substitute the following for the existing footnote:

'*Procedure for basic climatic and durability test for optical instruments: Part 10 Bump test.

†Procedure for basic climatic and durability test for optical instruments: Part 12 Shock test.'

(ME 31)

Reprography Unit, BIS, New Delhi, India

Indian Standard

SPECIFICATION FOR AUTOCOLLIMATOR

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(*Continued on page* 14)

Indian Standard

SPECIFICATION FOR AUTOCOLLIMATOR

0. FOREWORD

0.1 This Indian Standard was adopted by the Indian Standards Institution on 15 February 1979, after the draft finalized by the Optical and Mathematical Instruments Sectional Committee had been approved by the Mechanical Engineering Division Council.

0.2 Autocollimator is an instrument which functions both as a collimator and a telescope, and measures the displacement of image in its focal plane. An autocollimator of low sensitivity has a fixed graduated graticule in angular measure at its focal plane and for high sensitivity a dial micrometer is used to measure the displacements by movement of the setting graticule (*Fig.* 1 *to* 3).

0.3 Autocollimator may be used for measurement of angular deviations, flatness of surface plates and machine beds, parallelism of plates, blocks and cubes, squareness of relevant bearings of a machine, checking of circular tables and dividing heads against a master circular scale, etc. A list of accessories generally used with an autocollimator to perform these tests is given in Appendix A.

0.4 For the purpose of deciding whether a particular requirement of this standard is complied with, the final value, observed or calculated, expressing the result of a test, shall be rounded off in accordance with IS : 2-1960*. The number of significant places retained in the rounded off value should be the same as that of the specified value in this standard.

1. SCOPE

1.1 This standard specifies general an functional requirements of visual setting autocollimator of low and high sensitivity.

---

*Rules for rounding off numerical values (*revised*).

2. TERMINOLOGY

2.1 For the purpose of this standard the following definitions (*see* Fig. 1 to 3) in addition to those given in IS : 1399-1959* shall apply.

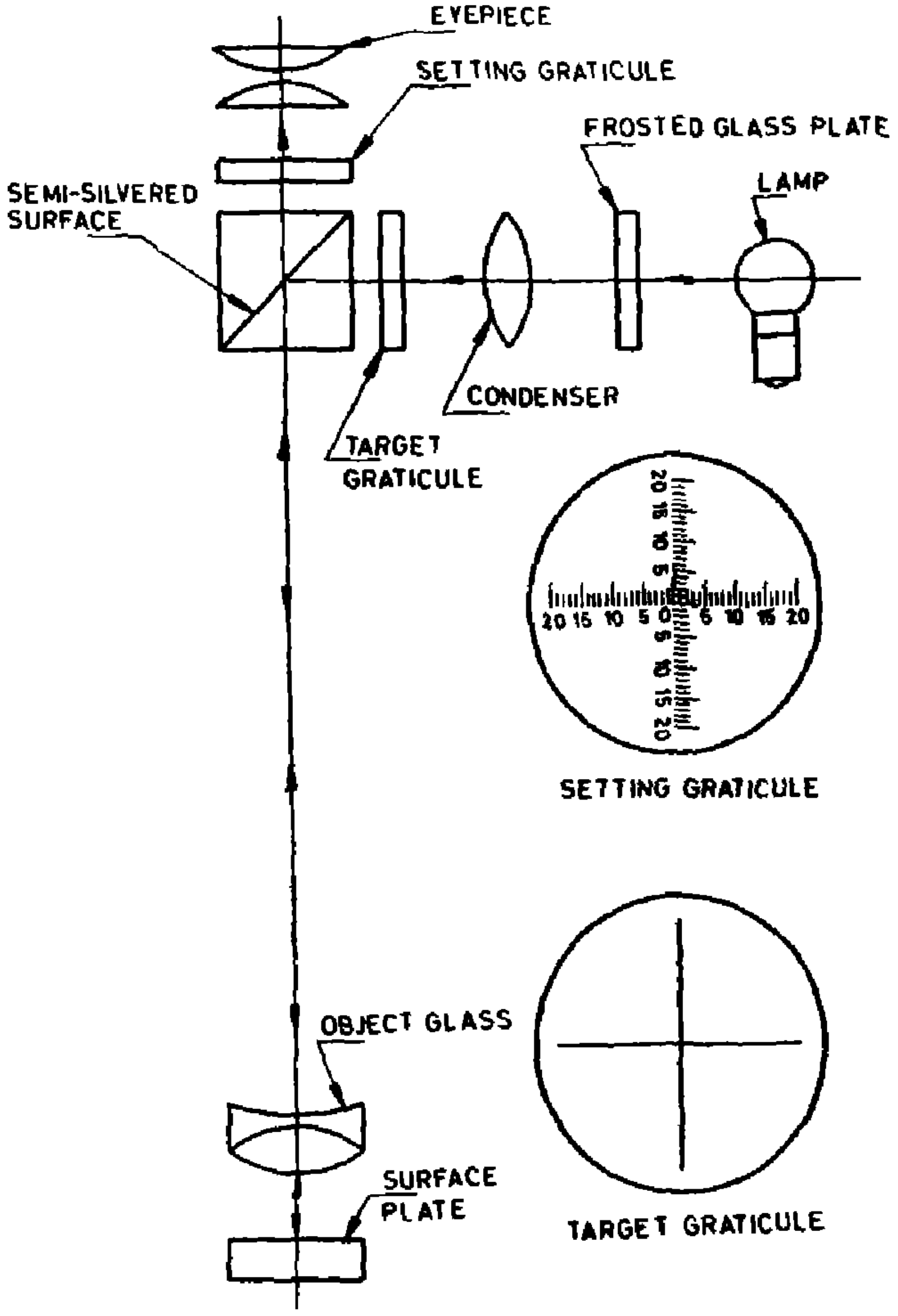

Fig. 1

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*Glossary of terms used in optical technology.

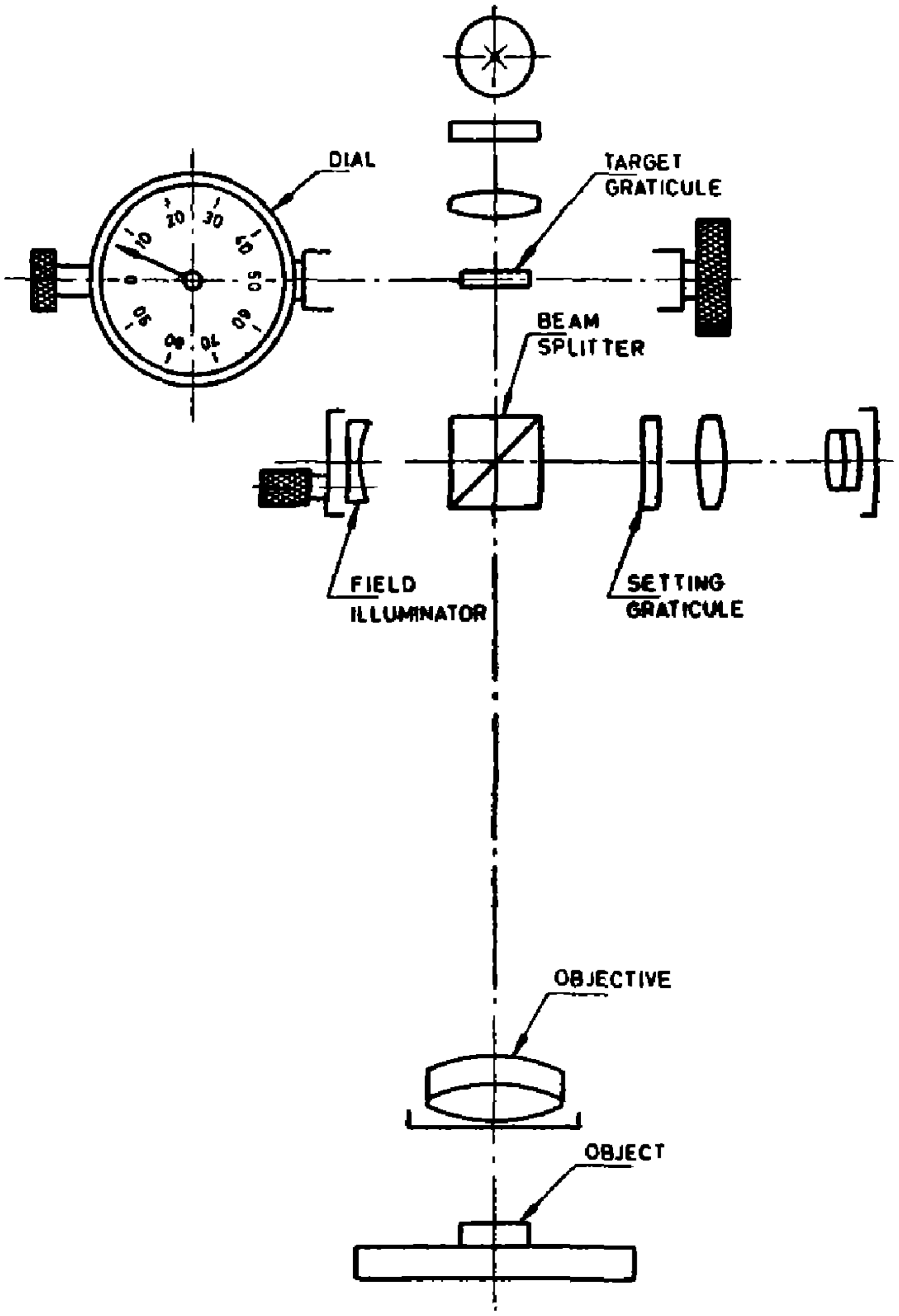
DIAL
TARGET GRATICULE
BEAM SPLITTER
FIELD ILLUMINATOR
SETTING GRATICULE
OBJECTIVE
OBJECT
0
10
20
30
40
50
60
70
80
90

FIG. 2

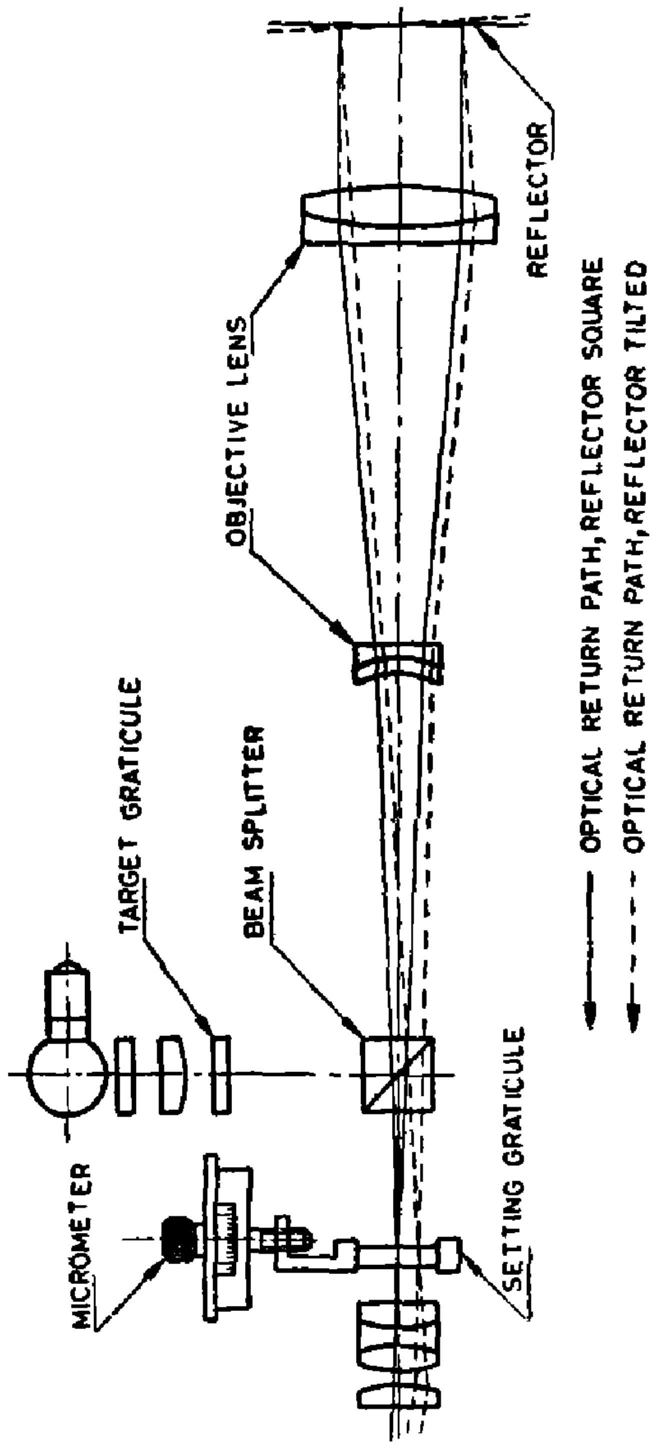
REFLECTOR
OBJECTIVE LENS
TARGET GRATICULE
BEAM SPLITTER
MICROMETER
SETTING GRATICULE
—— OPTICAL RETURN PATH, REFLECTOR SQUARE
- - - OPTICAL RETURN PATH, REFLECTOR TILTED

FIG. 3

2.1.1 *Illuminating Unit* — It houses a lamp for illuminating the target graticule uniformly with the help of a condenser.

2.1.2 *Target Graticule* — A glass graticule having two lines at 90° to each other.

2.1.3 *Beam Splitter* — A device by which a part of the incident luminous flux is reflected and a part of it transmitted.

2.1.4 *Setting Graticule* — A glass graticule having a scale along a horizontal and vertical line in case of low sensitivity autocollimator, and a cross line in dial micrometer type.

2.1.5 *Dial Micrometer* — A drum/dial having graduations used for measuring the displacement of setting/target graticule in angular measure.

2.1.6 *Eyepiece* — A Ramsden/Kellner type eyepiece for viewing the setting graticule located at its focal plane.

2.1.7 *Objective* — A well corrected optical system which has a target graticule and setting graticule at its focal plane. It emits and receives a parallel beam of light.

3. GENERAL REQUIREMENTS

3.1 The autocollimator shall conform to the general requirements laid down in 3 of IS : 2754-1964*.

3.2 Adjustments shall be provided to shift the position of the lamp in the vertical plane.

3.3 The lamp shall be of low voltage and of suitable intensity consistent with the requirements.

3.4 The lines graduations on glass graticules shall be well defined and uniform in thickness.

3.5 The eyepiece tube shall be engraved in dioptric power — 5D to + 5D with an interval of half dioptre marking and figured for every dioptre.

3.6 Low sensitivity autocollimator shall have a direct reading of minimum angular measure of 30 seconds and the range of measurement shall be ± 25 minutes of arc.

---

*General requirements for optical instruments.

3.7 High sensitivity autocollimator shall have a direct reading of minimum angular measure of 3 seconds or better and the range of measurement shall be ± 5 minutes of arc.

3.8 Material for micrometer shall be corrosion resistant and shall be of low coefficient of expansion.

3.9 The optical components shall conform to the requirements laid down in IS : 988-1959*.

3.10 Material for other components shall be free from flaws and defects.

3.11 The interior surfaces of the autocollimator shall be given a dull black coating.

4. FUNCTIONAL REQUIREMENTS

4.1 The autocollimator shall be a direct reading type giving the angle of tilt of the reflecting surface/mirror in the object plane from a reference plane.

4.2 The field of view as seen through the eyepiece shall be circular and uniformally illuminated.

4.3 The objective of the autocollimator shall have a well corrected system of suitable focal length and diameter to give the desired minimum displacement and resolution.

4.4 The magnification of the eyepiece shall be such that it resolves completely the image formed by the objectives. The eyepiece shall be adjustable to focus the eyepiece graticule within ± 5D and each dioptre mark shall be figured.

4.5 The target graticule and its back reflected image from a truly flat surface shall be in sharp focus and without any parallax error.

4.6 The setting graticule shall be coincident with the reflected image of target graticule when the movable graticule is lying at the central position of the measuring range in case of high sensitivity autocollimator.

4.7 The horizontal and vertical lines of both the target and setting graticule shall be perpendicular to each other to an accuracy of ± 5 minutes of an arc.

---

*General requirements for optical components.

4.8 The movement of the setting/target graticule with dial micrometer knob shall be smooth. There shall be no appreciable backlash in its movement.

4.9 The setting/target graticule shall be rotatable from the central position to ± 90°.

4.10 The autocollimator shall have at least a working distance of 6 metres.

4.11 Optical and Mechanical Alignment — The tube shall be square with the optical axis such that the reflected image due to a flat placed in contact with the tube end, shall be within the field of view for the low sensitive type autocollimator and within 30 seconds from the centre for the high sensitive type.

5. TESTS

5.1 General Requirements Tests

5.1.1 *External* — The instrument shall be initially checked for the following external defects:

a) Loose, missing, or damaged screws, nuts and other small parts;

b) Damage to optics, lamp and accessories;

c) Damage to the upper surface of the base, and

d) Damage to engravings and external finish.

5.1.2 *Internal* — The instrument shall be checked for the following internal defects:

a) Scratched, chipped or dirty optics;

b) Damage to optical parts, graticules, beam splitter;

c) Deterioration of optical cement, semi silvering coating of the beam splitter and anti reflection coating,

d) Filming of fungus growth on the optical surfaces;

e) Bubbles, striae, stones, greyness, cloudiness or milky appearance on optical components;

f) Lack of sharpness and clarity of graticule lines and any dust or dirt in the field of view; and

g) Any stray light from the interior surfaces affecting the vision.

5.1.3 The instrument shall be checked for the smooth and adequate movement of the eyepiece and micrometer.

5.2 Performance Tests

5.2.1 *Optical*

5.2.1.1 *Focussing* — The autocollimator shall be tested for focus by sighting it against a collimator or traversing a small aperture plate (approx 5 mm in dia) across the objective when sighted to a truly flat surface reflector. There shall be no movement of the reflected image with respect to setting graticule.

5.2.1.2 *Magnification* — The magnification of the autocollimator shall be tested by the method specified in Appendix C of IS : 2754-1964*. The measured value shall not differ by more than 5 percent from the specified value.

5.2.1.3 *Definition* — The definition of the autocollimator shall be tested with the help of a definition board given in Appendix E of IS : 2754-1964*. The circles, lines and squares of the board shall appear sharply defined without any distortion and colour over two-thirds of the field of view. The definition and freedom from colour over the remainder of the field shall be reasonably satisfactory.

5.2.1.4 *Resolution* — The resolving power of the autocollimator shall be measured by the method specified in Appendix F of IS : 2754-1964*. The measured value shall not differ by more than ± 5 percent from the specified value.

5.2.1.5 *Setting and target graticule* — The setting graticule and the image of the target graticule after reflection from a truly flat surface placed normal to the optic axis shall be in sharp focus and without any parallax when viewed through the eyepiece. The error in parallelism between the setting graticule and target graticule shall be within 30 seconds.

5.2.1.6 *Accuracy of graticule scale and micrometer* — The accuracy of the autocollimator shall be checked by an accurate sine bar, angle division tester or theodolite of an accuracy better than the autocollimator being tested. The error in each graduation shall not be more than 2 seconds or half of the least count in case of micrometer type of autocollimator.

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*General requirements for optical instruments.

5.2.1.7 *Working distance* — When a front reflecting mirror is placed normal to the collimator axis at a distance of 6 metres, a well defined image of the target graticule shall be seen in the collimator.

5.2.2 *Durability Tests*

5.2.2.1 *Vibration test* — The autocollimator without the base shall be clamped on to a vibrating table giving approximately 450 vibrations per minute with a maximum amplitude of 1·5 mm for a period of 10 minutes. After the test the performance of the autocollimator shall remain unimpaired.

5.2.2.2 *Bump and shock test* — The test shall be carried out as specified in IS : 2352-1963*.

6. MARKING

6.1 The autocollimator shall be marked at a suitable place with the manufacturer's name or trade-mark and the year of manufacture.

6.1.1 The autocollimator may also be marked with the ISI Certification Mark.

NOTE — The use of the ISI Certification Mark is governed by the provisions of the Indian Standards Institution (Certification Marks) Act and the Rules and Regulations made thereunder. The ISI Mark on products covered by an Indian Standard conveys the assurance that they have been produced to comply with the requirements of that standard under a well-defined system of inspection, testing and quality control which is devised and supervised by ISI and operated by the producer. ISI marked products are also continuously checked by ISI for conformity to that standard as a further safeguard. Details of conditions under which a licence for the use of the ISI Certification Mark may be granted to manufacturers or processors, may be obtained from the Indian Standards Institution.

7. PACKING AND PACKAGING

7.1 The autocollimator shall be delivered in a thoroughly clean and dry condition free from all traces of foreign material.

7.2 The metal parts shall be given protective costings to protect the instrument from humid and saline atmosphere.

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*Procedure for basic climatic and durability tests for optical instruments.

7.3 The autocollimator shall then be placed in its case and held securely in position.

7.4 A bag containing requisite amount of activated silica gel shall be placed inside the case.

7.5 The empty spaces, if any, shall be filled with suitable size of bags stuffed with dry cotton.

7.6 The case with its contents shall be locked during transit and keys attached to one of its handles.

7.7 The case shall then be packed in a packing box lined with water proof paper using dried cotton waste as cushioning material. The lid should be screwed down.

7.8 The package shall be marked with the description, number of contents, the standard symbol for indicating fragile contents, the symbol 'THIS WAY UP' and the legend 'INSTRUMENT, HANDLE WITH CARE' in red.

APPENDIX A

(*Clause* 0.3)

ACCESSORIES

A-1. The following accessories are generally used with the autocollimator.

A-1.1 Reflecting Mirror — Reflecting mirror is placed normal to the autocollimator axis to reflect back the image of target graticule which helps in studying the straightness of surface plates and alignment of machine beds, etc. The surface flatness of the front aluminised mirror shall be within 0 00008 mm for a 50 mm reflector.

A-1.2 Angle Gauges — Angle gauges are used for setting up angular comparison standards. The gauges shall have the flatness of working faces within 0 000 25 mm and angular accuracy within 2 seconds of arc of the nominal value.

A-1.3 Glass Polygons — Polygons are used for checking the circular scales at known regular intervals limited by the faces of the polygen. The surface flatness of the reflecting faces of the polygons shall be within 0·000 08 mm and angle between the faces shall be within 5 seconds.

A-1.4 Glass Cube — Cube is used as a 90 degree angle standard in two planes. The surface flatness of its polished faces shall be within 0·000 08 mm and angular accuracy within 3 seconds of arc.

A-1.5 Optical Squares — Optical square is a pentagonal prism to establish an axis at 90° to the axis of the autocollimator. The surface flatness of the polished faces shall be within 0·000 08 mm and the angular accuracy of the deviation of beam within 90° ± 3 seconds of arc.

A-1.6 Rhomboid Prism — Rhomboid prism is used for displacing the autocollimator's line in sight parallel to the normal so that the relationship of one part to another may be compared without repositioning the autocollimator. The incoming and outgoing rays in rhomboid prism shall be parallel within 3 seconds of arc and polish faces shall be flat within 0·000 08 mm.

A-1.7 Stand — For mounting the autocollimator in any position for measuring angles by comparison, the stand shall consist of a base plate and a pillar with a bracket for holding autocollimator so that it may be slided and positioned from 0° to 180°. The flatness of the base plate shall be in accordance with Grade 1 surface plates covered in IS : 2285-1974*.

---

*Specification for cast iron surface plates (*first revision*)

(*Continued from page* 2)

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Base Units

Quantity	*Unit*	*Symbol*
Length	metre	m
Mass	kilogram	kg
Time	second	s
Electric current	ampere	A
Thermodynamic temperature	kelvin	K
Luminous intensity	candela	cd
Amount of substance	mole	mol

Supplementary Units

Quantity	*Unit*	*Symbol*
Plane angle	radian	rad
Solid angle	steradian	sr

Derived Units

Quantity	*Unit*	*Symbol*	*Definition*
Force	newton	N	1 N = 1 kg. m s^2
Energy	joule	J	1 J = 1 N.m
Power	watt	W	1 W = 1 J/s
Flux	weber	Wb	1 Wb = 1 V.s
Flux density	tesla	T	1 T = 1 Wb/m^2
Frequency	hertz	Hz	1 Hz = 1 c/s (s^{-1})
Electric conductance	siemens	S	1 S = 1 A/V
Electromotive force	volt	V	1 V = 1 W/A
Pressure, stress	pascal	Pa	1 Pa = 1 N/m^2

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